HI-RES RAPID REFRESH (HRRR)
Initial Implementation V1.0.0

Kickoff Planning Meeting

June 16, 2014

Presented by: Geoff Manikin
Collaborators: Curtis Alexander, Stan Benjamin, Steve Weygandt, David Dowell, Eric James, Ming Hu, Tanya Smirnova, John Brown, Joe Olson, and the rest of the ESRL/GSD crew

Jianbing Yang/Becky Cosgrove NCO

Charter Overview

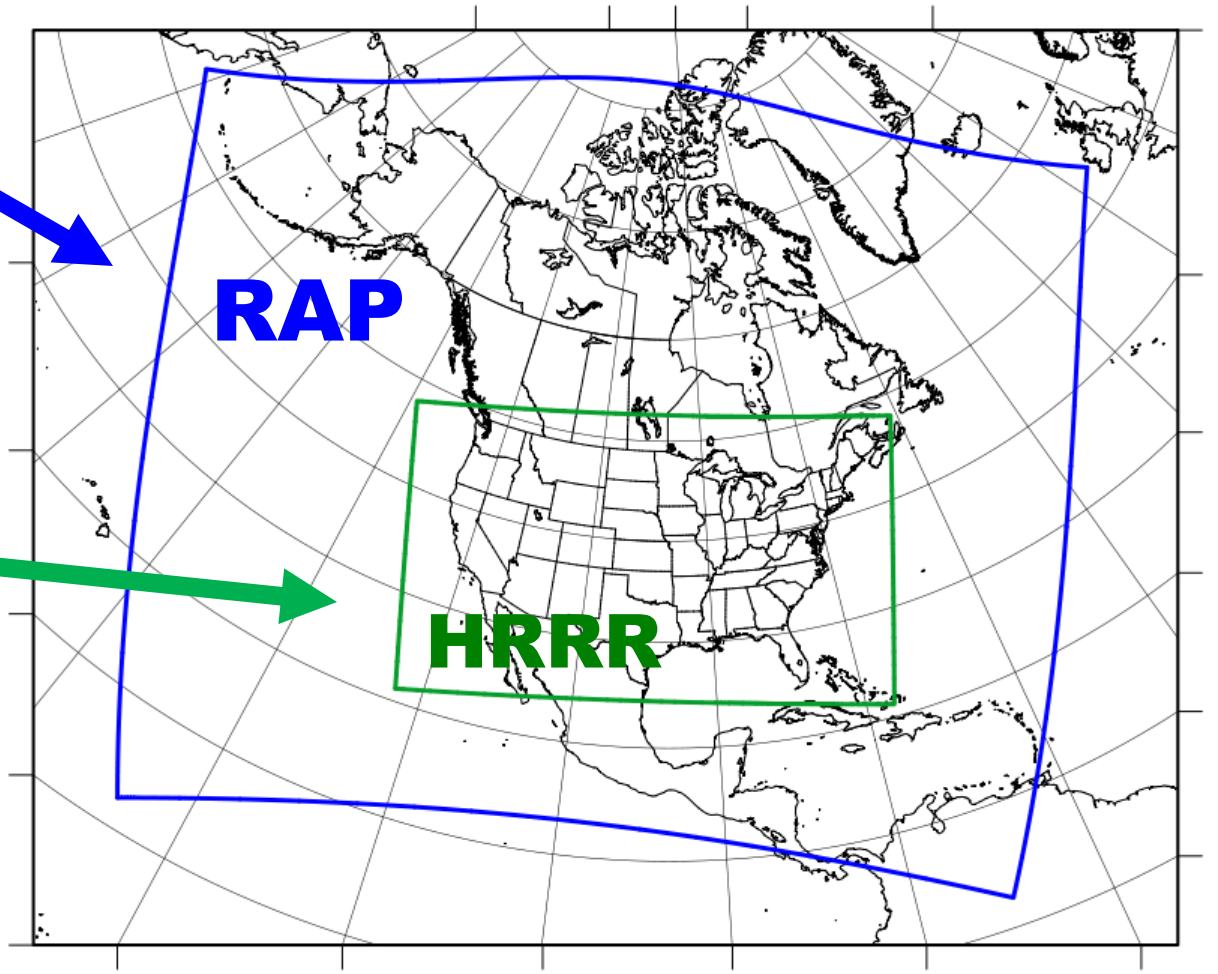
- **This project is an NWS and NCEP Annual Operating Plan (AOP) milestone for Q4 FY2014**
- **Implementation scheduled for September 2014**
- **Hi-Res Rapid Refresh description**
  - **Used by SPC, AWC, WPC, FAA and others for details short-range forecasts, especially convective evolution**
  - **24 cycles/day – each run out to 15 hours**
  - **No cycling**

Rapid Refresh and HRRR
NOAA hourly updated models

13km Rapid Refresh (RAP)
(mesoscale)

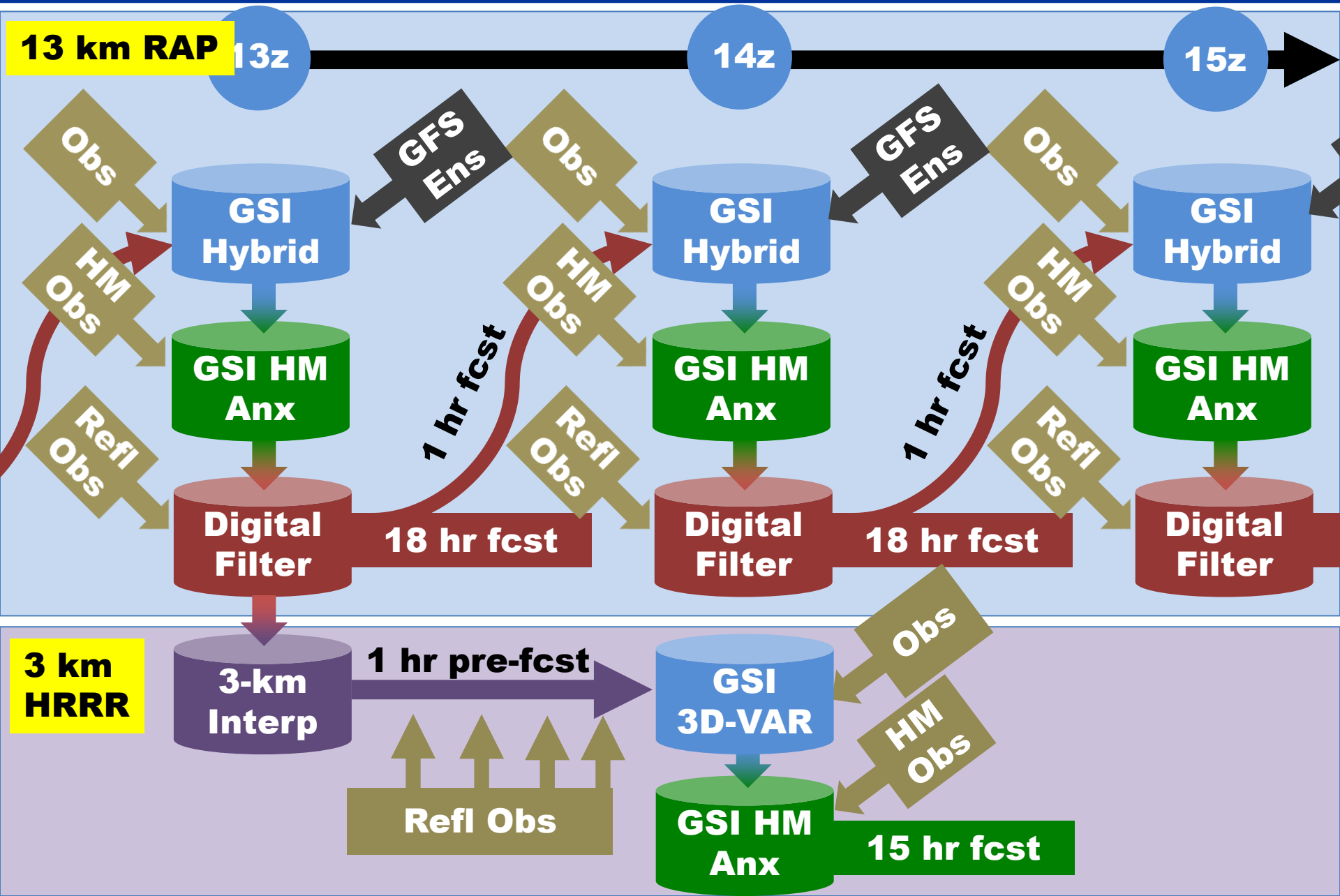
V2 in ops: 2/25/14

3km HRRR
(storm-scale)



High-Resolution Rapid Refresh
Scheduled NCEP Implementation Q4 2014

HRRR Initialization from RAPv2



Basic Overview

- Runs every hour (24/day)
- Uses previous hour's RAP analysis interpolated from 13 km to 3 km to initiate pre-forecast period
- Uses previous hour's RAP forecast for boundary conditions (01/13z HRRR use 2-hr old RAP due to 00/12z RAP having later start time)
- Runs a 1-hr spin-up forecast, using temperature tendencies obtained from processing radar data every 15 minutes to help properly initialize ongoing precipitation
- Runs a 3 km GSI after spin-up forecast to assimilate new data
- Model forecast is integrated out to 15 hours
- Full post-processing is done for every forecast hour; subset of fields is post-processed every 15 minutes
- Bufr output and gempak data generated for each forecast hour

Structure – Part 1: Before the Forecast

- Interpolation of RAP guess: 4 min ←
- Process radar data: 4 min ← Simultaneous
- Make boundary conditions: 13 min (not needed until free forecast)
- Process cloud data: < 1 min ←
- Generate temp. tendencies: 2.5-3 min ← Simultaneous
- 1-hr spinup forecast: 7 min
- GSI (analysis): 6-7 min

4 min + 3 min + 7 min + 6 min = 20 min

Structure – Part 2: Forecast and Products

- 15-hr model forecast: ~41 min
- Simultaneous hourly post-processing: 3 min each
- Simultaneous hourly wrfbufr: 1-2 min each
- Simultaneous subhourly post-processing: 2 min each
- Sounding post (bufr): 2 min
- Gempak: runs alongside post manager

RESOURCES – allocated 75 nodes

- Interpolation of RAP guess: 6 nodes
- Process radar data: 4 min: 4 nodes

← Simultaneous ←

- Make boundary conditions: 6 nodes
- Process cloud data: 1 node
- Generate temp. tendencies: 1 node

← Simultaneous ←

- 1-hr spinup forecast: 75 nodes
- GSI (analysis): 30 nodes

- 6 or 7 minute overlap between the spinup forecast and the boundary processing
- Hoping to speed up forecast job to be able to run with fewer nodes
- Makebc is divided into 3 parts (2 min, 3 min, 8 min); could break it up into 3 jobs and run most of final piece alongside the GSI

RESOURCES – allocated 75 nodes

- 15-hr model forecast: 70 nodes
- Simultaneous hourly post-processing: 2 nodes each
- Simultaneous hourly wrfbufr: 1 node each
- Simultaneous sub-hourly post-processing: 2 nodes each
- Sounding post (bufr): 1 node (shared)
- Gempak: 1 node (shared)

- Maximum overlap is 2 hourly post jobs, 2 subhourly post jobs, the gempak job, and 1 wrfbufr job for a system total of 80 nodes
- Hoping to speed up forecast job to be able to run with fewer nodes
- Could eliminate sub-hourly post-processing or bufr soundings but overall footprint for those is small

Resources

- Allocated 75 nodes
- Simultaneous hourly post-processing: 3 min each
- Simultaneous hourly wrfbufr: 1-2 min each
- Simultaneous subhourly post-processing: 2 min each
- Sounding post (bufr): 2 min
- Gempak: runs continuously waiting for files to become available: 42 min

DEPENDENCIES

UPSTREAM: RAP, RAP obs processing, RAP "early" 00/12z obs processing

DOWNSTREAM: RTMA (eventually), HRRRE-TL (eventually)

Upstream dependency requires following enhancements:

1. Need Phase 2 of ObsProc implemented
2. No changes to RAP needed

TIN: To be prepared and issued in late June

What Still Needs to Be Done

- NCO needs to put grib2 post into parallel and add in NDFD processing (need g2 template library fix)
- Need to give NCO changes to generate sub-hourly output
- Downscale NDFD 2.5 output
- Add backup capability for radar data
- Build in contingencies for missing RAP cycles
- Clean up grib2 labeling issues
- Add entries to gempak tables
- Set up alerts
- Make hpss decisions
- Make post-DFI RAP guess available for GSD comparison runs

DEVELOPMENT TESTING

- **CONUS HRRR run at GSD for 4+ years**
- **Built at EMC Jan-April**
- **Using 2013 version except for bug fix to address cold bias over snow pack**
- **NCO parallel running stably and generating grib2 and bufr output for several weeks. gempak output for over a week**

Recommended plan: run functional parallel for 30 days to assess stability (July)

- will freeze code in terms of science changes but will likely be ironing out product issues

Recommended length of time for official evaluation parallel: 30 days (August)

- frozen code

PROPOSED EVALUATION TEAM

Organization	Recommended	Optional (nice to have)
NCEP Centers	EMC, NCO	
NCEP Service Centers	WPC, SPC, AWC	OPC, TPC
NWS Region / WFO	ER, CR, SR, WR	
Other NWS or NOAA components		
External Customers / Collaborators	FAA	

PRODUCTS

For each forecast hour (16), generate

- 3 km file with data on pressure levels 350 MB (each file)
- 3 km file with data on native levels 545 MB
- 3 km file with mostly 2-D (surface) data 82 MB
- 2.5 km NDFD file for AWIPS 96 MB
- bufr sounding file 22 MB gempak file 210 MB

16.4 GB per cycle / 400 GB per day

gempak files add 3.3 MB per cycle/ 80 GB per day

For every 15 minutes, generate

- 3 km file with very limited 2-D (surface) data 22 MB
- Time labels are in minutes
- Cat 15/30/45/60 past hour into a single file 75 MB

1.1 GB per cycle / 26.4 GB per day

Initial Analysis of Product Volume

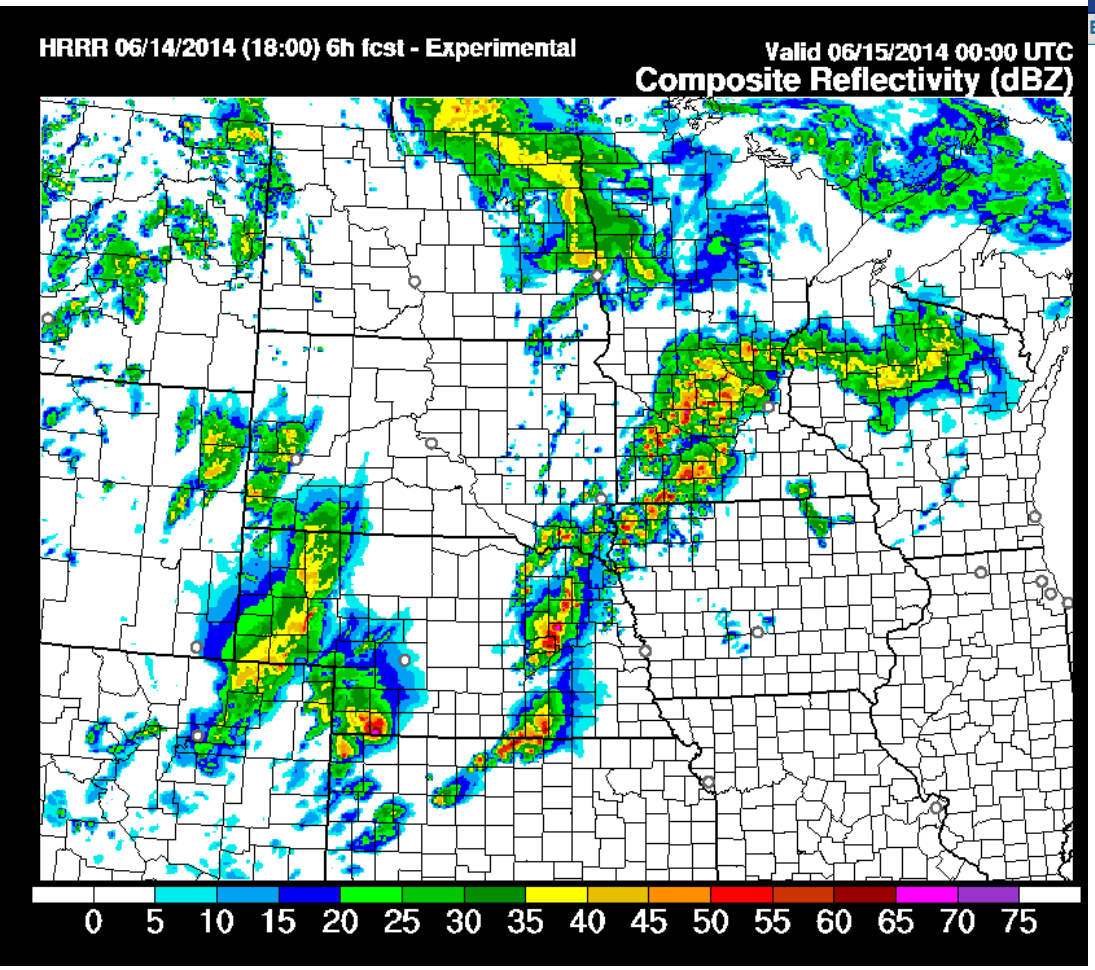
Disk Usage	**Current Production**	**Expected New Production**	**Actual New Production**
IBM Disk	-	1.6 TB/day	-
IBM Tape	-	TDB	-
NCEP FTP Server	-	425 GB/day	-
NWS FTP Server	-	Same?	-

MAG

- Original suggestion was to mimic RAP output and add in a few more parameters
- But is any value gained over the RAP showing upper level heights/winds/thicknesses/etc.. ?
- Should focus on 2-d “surface” fields and take advantage of the hi-resolution
- 15 minute output probably not an option?
- Break down by regions?

GSD HRRR Web Page

rapidrefresh.noaa.gov/HRRR/welcome.cgi



HRRR Model Fields – Experimental

rapidrefresh.noaa.gov/HRRR/Welcome.cgi?dsKey=hrrr_jet&domain=t2&run_time=14+Jun+2014+-+18Z

manikin@noaa.gov -... | Severe Potential: June 14th-19th – P... | HRRR Model Fields – Experimental

tem Research Laboratory
ution Rapid Refresh (HRRR)

Branch (AMB) Projects GSD Home ESRL Home

HRRR Model Fields - Experimental

Model: HRRR-primary Area: NC Date: 14 Jun 2014 - 18Z

Model: HRRR-primary Domain: NC Date: 14 Jun 2014 – 18Z

	All times	Loop	Valid Time: Sat 18	Sat 19	Sat 20	Sat 21	Sat 22	Sat 23	Sun 00	Sun 01	Sun 02	Sun 03
			Forecast: 00	01	02	03	04	05	06	07	08	09
all fields			00	01	02	03	04	05	06	07	08	09
1 km agl reflectivity	✓	✓	00	01	02	03	04	05	06	07	08	09
composite reflectivity	✓	✓	00	01	02	03	04	05	06	07	08	09
ensemble comp reflectivity	✓	✓	00	01	02	03	04	05	06	07	08	09
max 1 km agl reflectivity	✓	✓		01	02	03	04	05	06	07	08	09
surface CAPE	✓	✓	00	01	02	03	04	05	06	07	08	09
surface CIN	✓	✓	00	01	02	03	04	05	06	07	08	09
mixed CAPE	✓	✓	00	01	02	03	04	05	06	07	08	09
most unstable CAPE	✓	✓	00	01	02	03	04	05	06	07	08	09
most unstable layer CAPE	✓	✓	00	01	02	03	04	05	06	07	08	09
best LI	✓	✓	00	01	02	03	04	05	06	07	08	09
LCL	✓	✓	00	01	02	03	04	05	06	07	08	09
0-1 km shear	✓	✓	00	01	02	03	04	05	06	07	08	09
0-6 km shear	✓	✓	00	01	02	03	04	05	06	07	08	09
0-1 km helicity, storm motion	✓	✓	00	01	02	03	04	05	06	07	08	09
0-3 km helicity, storm motion	✓	✓	00	01	02	03	04	05	06	07	08	09
2-5 km updraft helicity	✓	✓	00	01	02	03	04	05	06	07	08	09
1-6 km updraft helicity	✓	✓	00	01	02	03	04	05	06	07	08	09
2-5 km max updraft helicity	✓	✓		01	02	03	04	05	06	07	08	09
1-6 km max updraft helicity	✓	✓		01	02	03	04	05	06	07	08	09
ensemble updraft helicity	✓	✓	00	01	02	03	04	05	06	07	08	09
convective activity 1	✓	✓		01	02	03	04	05	06	07	08	09
convective activity 2	✓	✓		01	02	03	04	05	06	07	08	09
convective activity 3	✓	✓		01	02	03	04	05	06	07	08	09
convective initiation 1	✓	✓		01	02	03	04	05	06	07	08	09

Hi-Resolution Rapid Refresh v1.0.0

Project Status as of 6/16/14

G

Project Information and Highlights

Lead: Geoff DiMego,/Geoff Manikin EMC and Chris Magee, NCO

Scope:

1. Initial version of 3 km Hi-Res Rapid Refresh
2. Similar to RAP but allows explicit convection
3. Initialized from previous hour's RAP analysis interpolated to 3 km. Radar data assimilated every 15 minutes to allow a one-hour "spinup" forecast, followed by a final 3 km GSI.
4. Output generated every 15 minutes of forecast

Expected Benefits:

1. Hourly hi-resolution forecasts of convective evolution and structure along with various parameters relevant to severe storm, aviation, and winter weather forecasting

Y

Scheduling

Milestone (NCEP)	Date	Status
EMC testing complete/ EMC CCB approval	6/30/2014	
Final code submitted to NCO	6/20/2014	
Technical Information Notice Issued	6/30/2014	
CCB approve parallel data feed	6/30/2014	
Parallel testing begun in NCO	6/30/2014	
IT testing begins	7/14/2014	
IT testing ends	7/28/2014	
Real time evaluation ends	9/3/2014	
Downstream test begins	8/12/2014	
Downstream testing ends	8/19/2014	
Management Briefing	9/9/2014	
Implementation	9/16/2014	

Y

Issues/Risks

Issues: Timing improved but still tight – no margin for error
Risks: Footprint on production machine still too large
Mitigation: working with IBM to optimize code and script settings

G

Finances

Associated Costs:

Funding Sources:

R	Management Attention Required	Y	Potential Management Attention Needed	G	On Target